

REMARKS

Applicants acknowledge the indication of the allowability of Claims 5-10, as set forth in paragraph 8 of the Office Action. In particular, the latter claims would be allowable if rewritten in independent form. However, for the reasons stated below, Applicants respectfully submit that Claims 5-10 are allowable in their current dependent form.

Claims 1-3, 12, 14, 15, 19 and 20 have been rejected under 35 U.S.C. §102(b) as anticipated by Zimmerman (U.S. Patent No. 6,126,196), while Claims 4, 11, 13, 16-18 and 21 have been rejected as unpatentable over Zimmerman in view of Matsui et al (U.S. Patent No. 3,861,712). However, as discussed below, Applicants respectfully submit that all claims of record in this application distinguish over both the Zimmerman and Matsui et al references, whether considered separately or in combination.

The present invention is directed to a method and apparatus for regulating the inflation of an automobile safety device, such as an airbag. In particular, it is desirable that the airbag be firmer in the event of a severe accident (which involves more severe loading of the airbag) in order to absorb more energy, and is softer in the event of a less severe accident (with less severe loading). In this manner, maximum safety and comfort of vehicle occupants is provided.

In order to accomplish this objective, the airbag arrangement according to the invention includes an orifice which is provided in the airbag itself, and which regulates a flow of gas into or out of the airbag during the inflation process. In the case of a more severe loading of the airbag, which generates higher pressure inside the airbag, the velocity of gas flow through the orifice increases, while in the case of less severe loading (and correspondingly lower pressures) the gas flow velocity through the orifice decreases. Therefore, in order to maintain a higher pressure during severe loading and a lower pressure during less severe loading, the orifice in the airbag has a flow resistance which is proportional to the velocity of gas flowing through it. This is accomplished by modifying the cross sectional area of the orifice in inverse proportion to the velocity of gas flowing through the orifice.

For the latter purpose, in a first embodiment, the orifice comprises a tube which is made of an elastic material, such that its cross sectional area expands or contracts in response to an increase or a decrease of the static pressure of the gases flowing through it. Since, according to the Bernoulli principle, the static pressure on a flowing gas decreases with increasing gas flow velocity, it follows that with such a configuration, the elastically expandable cross sectional area will increase and decrease in inverse proportion to the gas flow velocity. Thus, as noted previously, the flow resistance of the orifice varies in direct proportion with the gas flow velocity.

Claim 1 of the present application defines a safety device having a gas generator and an airbag, with an orifice through which gas can flow, which orifice has a variable flow resistance. In particular, Claim 1 recites that the flow resistance of the orifice "adjusts automatically as a function of flow velocity of gas flowing through the orifice". Similarly, Claim 20 is a method claim which recites a step of adjusting the fluid flow resistance of the orifice as a function of the flow velocity of gas flowing through the orifice. More particularly, Claim 2 recites that the flow resistance increases with increasing flow velocity, and vice versa, while Claims 22 and 23 recite that the cross sectional area of the orifice varies as an inverse function of the flow velocity.

Other embodiments are also disclosed, which utilize different techniques for adjusting the pressure inside the orifice. Claim 11, for example, recites that the walls of the orifice are gas permeable, while Claim 12 recites that they are perforated or that they have inner surfaces that have a contoured surface configuration.

The primary Zimmerman reference discloses an airbag module which has an outlet opening, through which gas flows, after a dwell time, during inflation of the airbag. In particular, the airbag according to Zimmerman includes an outlet opening located at the end of a tube-shaped mouthpiece on the airbag, which is turned into the airbag in its uninflated state. (Column 2, lines 32-34.) During inflation of the airbag, the tube 50 "begins to roll out to the outside", as noted at Column 3, lines 41-43. As a result, the effective volume of the airbag increases

with the unrolling of the tube 50, so that (if the length and diameter of the tube are properly selected relative to the gas generation parameters of the gas generator (Column 4, lines 8-10), the pressure in the airbag is held at a relatively constant value as the gas flows in, as shown by the solid line in Figure 4.

Due, however, to the fact that the tube is turned or rolled into the airbag, the opening at the end of the tube is not opened until the tube has in fact unrolled, as indicated at Column 2, lines 44-47, Column 3, line 45 through Column 4, line 3, and as shown in Figure 4. At point t6, when the tube has fully unrolled and the air outlet opening 40 is opened, the pressure falls off, as illustrated in Figure 4.

The only factor discussed in the Zimmerman reference, by which the pressure progression illustrated in Figure 4 is achieved, is the unrolling of the tube 50 with the resulting delay in the opening of the orifice at its end. (See, for example, Column 2, lines 27-34.) In particular, Zimmerman neither teaches nor suggests the provision of an airbag having an orifice with a flow resistance that adjusts automatically as a function of flow velocity of gas flowing through the orifice, as recited in Claim 1. Indeed, Zimmerman contains no discussion at all, which takes into consideration the velocity of the gases flowing through the orifice. Rather, as noted previously, it simply provides that the opening of the orifice is delayed during unrolling of the tube.

It is also noteworthy in this regard, that although the tube in Zimmerman would appear to be "flexible" in the sense that it can be turned or rolled up, it does not follow that it is made of an elastic material, or that the orifice has a cross sectional area which is capable of increasing or decreasing in response to kinetic pressure from the expanding gases in the airbag. Rather, the sole effect discussed and utilized in the Zimmerman reference is the unrolling of the tube, which has in turn the effect of delaying the opening of the orifice, and of maintaining constant pressure within the airbag as the tube unrolls. Nothing contained in Zimmerman suggests that the cross sectional area of the tube 50 is adjustable as a function of the flow velocity of gas flowing through the orifice, or that the cross sectional area of the orifice is adjustable in inverse proportion to the gas flow velocity.

The Matsui et al reference, on the other hand, is cited as disclosing a vehicle airbag having a second orifice of essentially constant size. Like Zimmerman, however, Matsui et al fails to teach or suggest the provision of an orifice having an adjustable cross section and flow resistance, as described previously. Accordingly, the claims of the present application also distinguish over the combination of Zimmerman and Matsui et al.

With regard to Claims 4, 11 and 21 in particular, the Office Action states at page 4 that it would have been obvious to make the duct-shaped partial region according to the invention from an elastic material, causing the side walls of the duct-shaped region to be gas permeable. However, Applicants respectfully

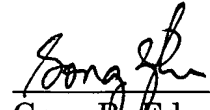
submit that flexibility of the material from which the duct is made, and its permeability are two different quantities, and do not necessarily relate. That is, a material may be flexible or elastic, without being gas permeable, and vice versa. Moreover, with regard to the elasticity of the walls of the duct, as recited in Claims 4, 11 and 21, it is noteworthy that a principle upon which the present invention is predicated, in particular that when an elastic material is used, the cross sectional area of the orifice will increase and decrease in inverse proportion to the speed of the gases flowing through it, is neither recognized nor considered in either of Zimmerman or Matsui et al. Accordingly, nothing in either reference suggests any motivation for or desirability of such a modification of either of those references.

Finally, the Office Action states that the choice of the selected material would not change the function of the designed. For the reasons set forth hereinabove, Applicants respectfully submit that it is the very elasticity of the material of which the orifice is made which permits it to function in the manner described above, according to a feature which is neither recognized nor discussed in either of the cited references.

If there are any questions regarding this amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #225/50657).

Respectfully submitted,

 Reg. No. 44,420

Gary H. Edwards

Registration No. 31,824

CROWELL & MORING, LLP
Intellectual Property Group
P.O. Box 14300
Washington, DC 20044-4300
Telephone No.: (202) 624-2500
Facsimile No.: (202) 628-8844
GRE:kms/095309